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ORIGINAL ARTICLE

# Influence of orotracheal intubation on preterm infant palate shape between 12 and 24 months old

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## Abstract:

**Introduction:** Mechanical ventilation (MV) is indicated in diverse clinical situations in which the individual develops acute or chronic respiratory failure. **Objective:** To evaluate the palate shape of preterm infants aged 12 to 24 months who were submitted to orotracheal intubation (OTI) and mechanical ventilation. **Methods:** This cross-sectional observational study included preterm infants submitted to MV by OTI for at least seven days, who weighed less than 2000 g at birth, and were attended at the Preterm Infant Care Outpatient Clinic of the University Hospital of the University of São Paulo and the Premature Infant Outpatient Clinic of the Children's Institute of the Clinics Hospital of the School of Medicine of the University of São Paulo. Sociodemographic data were collected from neonatal medical records of the participating children. The oral cavity was examined to classify palate shape into square, narrow or ovoid. Statistical analyses were performed using the ANOVA F, Kruskal-Wallis and Chi-square tests, with a 5% significance level. **Results:** The mean period of OTI was 25.3 ± 25.8 days, and the children presented a significantly higher percentage of narrow shaped palate ($p$<0.001). **Conclusion:** The palate in preterm infants submitted to invasive MV by OTI is predominantly narrow and deep.

**Keywords:** Preterm Infant; Respiration, Artificial; Intubation; Palate.

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## INTRODUCTION

Mechanical ventilation (MV) is indicated in diverse clinical situations in which the individual develops acute or chronic respiratory failure. It is considered a treatment method aimed at maintaining gas exchange and reducing respiratory discomfort[1]. Such respiratory care can be performed noninvasively through constant or variable pressure from ventilatory support. This technique of ventilatory support is known as continuous positive airway pressure (CPAP)[2,3]. Invasive assisted MV is achieved by orotracheal intubation (OTI), which consists of the placement of a naso- or orotracheal tube and performs the same function as noninvasive support[4].

There are clinical situations in which ventilatory support is indicated, such as respiratory distress syndrome, transient tachypnea of the newborn, meconium aspiration syndrome, bronchopulmonary dysplasia, pulmonary edema, newborns weighing less than 1500 g, and in the presence of any sign of increased respiratory work[5].

Preterm infants (PTI) are determined when they are born prior to 37 weeks of gestation, and may be classified according to gestational age (GA) and birth weight. Regarding weight, a PTI is defined by birth weight of less than 2500 g, and they are considered low weight neonates[6,7].

Prematurity is one of the main causes of perinatal morbidity in developed countries (6% and 10%), while in Brazil, the prevalence is 10% and 12% of all births[8]. The main complications that affect PTI include anemia, hypocalcemia, hyperbilirubinemia, apnea, perinatal asphyxia, respiratory distress syndrome, hypoglycemia, rickets of prematurity, necrotizing enterocolitis[9].

In the early stages of oral cavity development, the palate bones are malleable and are subject to influences from external forces, like that of oral intubation due to inadequate suction, and can result in palatal deformity[8]. The PTI palate shows intense osteogenic activity and any pressure exerted on this area or the region of the alveolar ridge can cause an increase in osteoclastic activity, and eventual defects in the area subject to pressure.

Palate deformity resulting from MV by OTI remains a controversial issue in the literature. Thus, it is important to determine whether there is any relationship between morphological alterations in the palate of PTI between 12 and 24 months old and submission to invasive mechanical ventilation (IMV) by OTI. The purpose of this study was to evaluate the shape of the palate in children who were intubated during the neonatal period.

The null hypothesis considered was that no differences in palate shape occurred in preterm infants aged between 12 and 24 months, who were submitted to invasive mechanical ventilation by orotracheal intubation.

## MATERIAL AND METHODS

This study was approved by the Research Ethics Committee of the Department of Pediatrics, at the School of Medicine of the University of São Paulo (FMUSP) and the Research Ethics Committee of the University Hospital of the University of São Paulo (HU-USP), under protocol no. CEP-HU/USP:1049/10-SISNEP (CAAE: 0078.0,198,000-10).

This cross-sectional observational study was conducted from 2012 to 2014, on children attended at the Preterm Newborn Care Outpatient Clinic of the HU-USP and the Premature Newborn Outpatient Clinic of the Children's Institute of the Clinics Hospital (HC) of the FMUSP.

The study included 34 children of both sexes born in the maternity ward of the HU-USP or newborns who were hospitalized in the Neonatal Intensive Care Center 2 of the Children's Institute of the HC-FMUSP during the first 72 hours of life. The GA of the newborns selected was less than 37 weeks, their birth weight was less than 2000 g, they were between 12 and 24 months old at the time the data were collected (corrected age for preterm birth: postnatal age minus the number of days/weeks to complete 40 weeks at the time of birth), and had been submitted to IMV by OTI for at least seven days.

Children that had a diagnosis of congenital malformations, genetic syndromes and severe neurological sequelae that compromised facial development (hydrocephalus, microcephaly, cerebral palsy), and with no conclusive diagnosis of neurological syndromes and sequelae were excluded from the study.

The following sociodemographic data regarding the neonatal period were retrieved from each child's medical records: race, sex, GA, birth weight (grams), type of respiratory care (MV by OTI) and duration of intubation.

For the clinical examination, the child was placed in his/her mother's lap (or that of a guardian) while the oral cavity was examined using a headlight and tongue depressor spatulas in order to observe the shape of the palate, which was classified as square, narrow

or ovoid (Figure 1)[10]. The palatal arch was defined as follows: square, when the anterior teeth were arranged in a straight line; narrow, when the arch was atresic in the canine to canine region and the incisal edges of the teeth were projected in front of cervical anterior teeth; and ovoid when the arch was wider between the canine region and the inclination of the central incisor was slightly inward[11]. Photographic records of the palate of each child were made, so that a different examiner could evaluate palate shape based on the images.

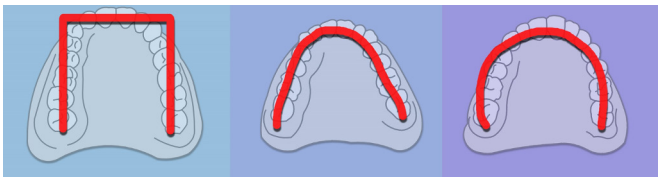

**Figure 1.** Reference palate shapes- Square, Narrow and Ovoid- adapted from Zarb et al.[10],1990.

Continuous variables were presented as mean, minimum, maximum and median values, with their respective standard deviations and interquartile ranges. Categorical variables were presented in absolute and relative frequency. Independence evaluation with other variables was analyzed by the Chi-square test. Comparisons between variables were performed by means comparison tests (ANOVA F test). Nonparametric tests were used (Kruskal-Wallis) when three groups were compared. A significance level of 5% was used to determine the validity of the hypothesis. All calculations were performed using R software, version 3.1.1 (R Core Team, 2014).

## RESULTS

The sample consisted of 34 premature children, 17 girls and 17 boys, with a mean GA of 29.3 ± 2.9 weeks, a mean birth weight of 1181.8 ± 335.8 g, and a corrected mean age of 15.4 ± 3.6 months, who were submitted to IMV by OTI (Table 1).

The degree of agreement obtained when comparing the clinical evaluation and photograph of the palate was a kappa of 0.89.

Regarding palate shape, children submitted to OTI presented a significant association ($p<0.001$) between OTI use and palate shape, with a significantly larger percentage (67.6%) of narrow palates (Figure 2) compared with square (14.7%) (Figure 3) and ovoid shapes (17.7%) (Figure 4) (Table 2).

No significant differences ($p>0.005$) were observed when comparing the sociodemographic variables according to palate shape in children submitted to OTI (Table 3).

## DISCUSSION

This study verified that PTI examined between 12 and 24 months old, who had been submitted to IMV by OTI at birth most frequently presented a narrow palate.

The literature confirms that reports on MV as the preferred treatment for PTI who present respiratory insufficiency go back more than 20 years[12-15]. In this study, the mean GA of PTI who were submitted to IMV by OTI was 29.3 weeks and mean birth weight was 1181.8 g, i.e. those who most needed to remain intubated were low weight PTI. These findings are in line with authors who reported the need for OTI in relation to birth weight, since 100% of the children born with a birth weight ≤ 1000 g require IMV by OTI, while 85.5% of children with a birth weight between 1001 g and 2500 g required IMV by IOT[12-15]. The duration of IMV by OTI is influenced by iatrogenic effects related to the palate[16-19]. Herein, the mean duration of OTI was 25.3 days, which is shorter than that observed by Fadavi et al.[20] and Hohoff et al.[21], who recommended a period longer than 30 days.

The main complication associated with OTI is the changes that can occur in the palatal architecture[20,22]. In their study, Hohoff et al.[8] made molds of the hard palate of 200 newborns and verified varying palate shapes: semicircular, flattened in the anterior region and elliptical arches. In children aged over 11 months, most jaws form a semicircular shape in the anterior region and converging edges, while from 16 to 24 months, the edges are parallel, and from 28 to 32 months, the edges diverge.

**Table 1.** Sociodemographic characteristics, duration of invasive mechanical ventilation by orotracheal intubation in preterm infants between 12 and 24 months old.

| Variable | n | Minimum | Maximum | Mean | SD | Median | 1st Q | 3rd Q |
|---|---|---|---|---|---|---|---|---|
| Age (months) | 34 | 12 | 24 | 15.4 | 3.6 | 14.5 | 12.3 | 17.0 |
| Gestational age (weeks) | 34 | 25.5 | 36.3 | 29.3 | 2.9 | 28.8 | 27.2 | 30.1 |
| Birth weight (g) | 34 | 575 | 1998 | 1181.8 | 335.8 | 1107.5 | 963.8 | 1338.8 |
| OTI (days) | 34 | 7 | 120 | 25.3 | 25.8 | 15.0 | 7.0 | 33.8 |

n = sample size; SD = standard deviation; Q = quartile; g = grams; OTI = orotracheal intubation.

**Figure 2.** Narrow palate in preterm infants submitted to invasive mechanical ventilation by orotracheal intubation

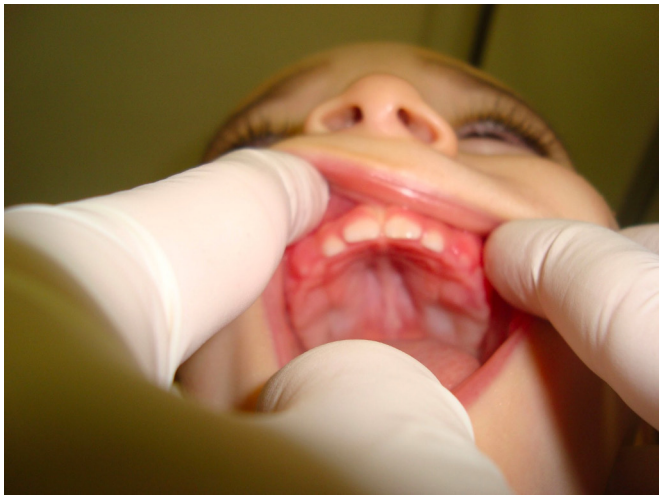

**Figure 3.** Square palate in preterm infants submitted to invasive mechanical ventilation by orotracheal intubation

**Figure 4.** Ovoid palate in preterm infants submitted to invasive mechanical ventilation by orotracheal intubation

However, we were not permitted to use this classification by the Research Ethics Committee of the HU-USP, since this approach was considered too invasive, that is, making molds of the palates could further contribute to the children's emotional trauma, given that they have already undergone numerous manipulations due to being born prematurely.

Another factor that may be associated with palatal depth deformity is the pressure exerted directly by the orotracheal tube on the medial region of the palate, as reported in previous studies[15,23-25]. Use of a protector on the OTI cannula can minimize its impact on palatal deformity[14,25]. Ash & Moss[25] conducted a study consisting of two groups of 15 PTI who were intubated for more than 10 days, in which one group was provided with a cannula protector.

The group in which protection was used presented a less narrow, less deep palate following the period of intubation compared with those that did not receive this protection. According to the authors, the cannula protector alleviates the pressure of the orotracheal tube on the palate, since in addition to promoting greater tube stability (diminished movement and decreased risk of disconnection), it also distributes the load more homogeneously and over a larger area of the palate[16,25]. The children in this study did not receive the protection recommended by these authors, partly because is not common practice among the neonatologists in the participating services, and partly because dentists, who could have assisted in this practice, are not included in the neonatology multidisciplinary team.

The clinical relevance of the study lies in the fact that children who were submitted to IMV by OTI frequently develop a narrow, deep palate. This situation favors the occurrence of malocclusions, including uni- or bilateral anterior or posterior crossbite and dental crowding. Considering the potential risks, evaluation by a dentist in the early phase of diagnosis is essential, not only because of malocclusions, but because inadequate positioning of the tongue can result in alterations in neurovegetative functions. Preventive goals or forms of early treatment should be proposed to minimize possible damage to the oropharyngeal system of these children, as well as long-term follow-up by a dentist.

## CONCLUSION

Herein, preterm infants submitted to invasive mechanical ventilation by orotracheal intubation predominantly presented narrow, deep palates.

**Table 2.** Palate shape in preterm infants between 12 and 24 months old submitted to invasive mechanical ventilation by orotracheal intubation.

| Variable | OTI n = 34 | % | *p* value[1] |
|---|---|---|---|
| Palate shape | | | |
| Square | 5 | 14.7 | |
| Narrow | 23 | 67.6 | <0.001 |
| Ovoid | 6 | 17.7 | |

n = sample size; OTI = orotracheal intubation; [1]Chi-square test.

**Table 3.** Comparison between study variables, according to palate shape in preterm infants between 12 and 24 months old submitted to orotracheal intubation.

| Variable | Palate Shape | | | | | | | | *p* value | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Square (n = 5) | | Narrow (n=23) | | Ovoid (n = 6) | | Total (n = 34) | | | |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | ANOVA | K-W1 |
| Age (months) | 13.8 | 1.8 | 15.5 | 3.4 | 16.3 | 5.2 | 15.4 | 3.6 | 0.5 | 0.664 |
| Gestational age (weeks) | 29.0 | 2.4 | 29.0 | 3.0 | 30.6 | 2.7 | 29.3 | 2.9 | 0.503 | 0.338 |
| Birth weight (g) | 1069.0 | 205.6 | 1161.4 | 284.5 | 1354.2 | 551.3 | 1181.8 | 335.8 | 0.338 | 0.522 |
| OTI (days) | 28.6 | 27.9 | 27.8 | 28.0 | 13.2 | 10.5 | 25.3 | 25.8 | 0.458 | 0.314 |

n = sample size; SD=standard deviation; g=grams; OTI=orotracheal intubation; [1]Kruskal-Wallis.

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